Effect of Alloying Additions on the Corrosion Behavior of Zinc

Bo Zhang and Alison J. Davenport
The University of Birmingham, Metallurgy and Materials
Edgbaston, Birmingham B15 2TT

It has been reported that it is possible to improve corrosion resistance of zinc by alloying[1-6]. In this paper, the effect of small additions of alloying elements (Cu, Zr and Sb) on the corrosion behavior of commercially-pure zinc was investigated. The results were compared with those for commercially-pure zinc (Z1) and a commercial alloy containing Pb (Z2). Experiments were carried out in 0.1M NaCl and a solution of $NaCl/Na_2SO_4/NaHCO_3$ designed to simulate atmospheric corrosion. The surface morphologies before and after corrosion tests were investigated by optical microscopy (OM) and scanning electron microscopy (SEM/EDX).

The results of dynamic polarization (Figures 1 and 2) showed that Pb promoted cathodic reactivity and decreased the pitting potential in both solutions compared with commercial zinc. Sb (1%) slightly increased the rate of the cathodic reaction with less effect on anodic behavior. However, Cu (0.2% and 1%) slightly increased pitting potential with less effect on cathodic reaction. Zr (0.2%) was found to have no effect on corrosion behavior.

The results of immersion and continuous linear polarization tests (Figure 3) showed that addition of Sb or Zr had no effect on the corrosion of commercially-pure zinc (Z1). The effect of Cu was found to depend on concentration: 1%Cu was found to be harmful, decreasing the linear polarization resistance significantly, while 0.2%Cu increased the linear polarization resistance.

Optical microscopy and SEM investigations showed localized attack for Cu(1%) and the Pb-containing alloy Z2 after the 20 h immersion test, while the other alloys showed uniform corrosion morphology.

References:

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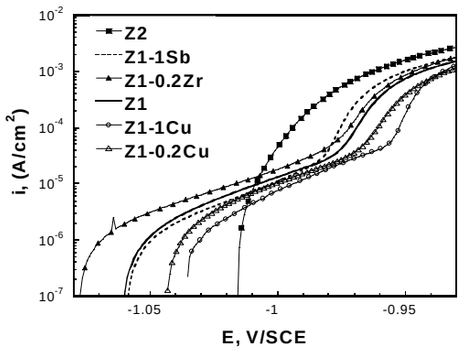

Figure 1. Effect of alloying additions on anodic polarization curves of zinc in 0.1M NaCl, pH 6, 1 mV/s

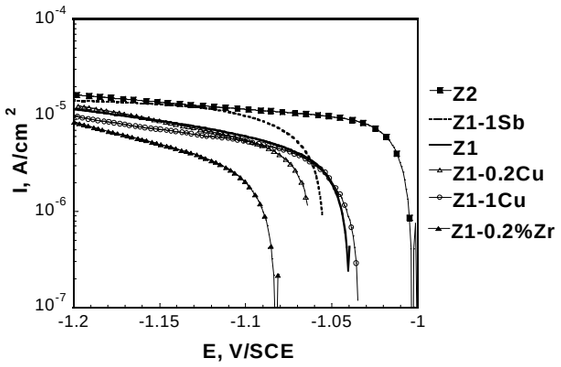

Figure 2. Effect of alloying additions on cathodic polarization curves of zinc in 0.1M NaCl, pH 6, 1 mV/s

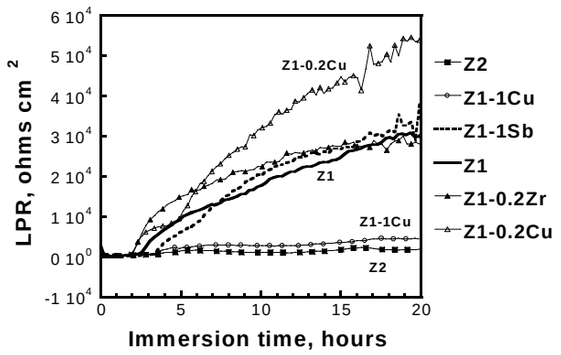

Figure 3. Linear polarization resistance (LPR) of zinc alloys after 20 h continuous immersion tests in $0.2MNaCl/0.2MNa_2SO_4/0.01NaHCO_3$ solution.